NON-PUBLIC?: N
ACCESSION #: 8910030097
LICENSEE EVENT REPORT (LER)

FACILITY NAME: DIABLO CANYON UNIT 2 PAGE: 1 OF 7

DOCKET NUMBER: 05000323

TITLE: MANUAL REACTOR TRIP DUE TO REACTOR COOLANT PUMP ELECTRICAL FAULT
DUE TO A FAILURE OF A LOAD SIDE BOLTED TERMINATION
EVENT DATE: 08/28/89 LER #: 89-008-00 REPORT DATE: 09/27/89

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73 (a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: TERENCE L. GREBEL, REGULATORY COMPLIANCE SUPERVISOR

TELEPHONE: (805) 595-4720

COMPONENT FAILURE DESCRIPTION:
CAUSE: B SYSTEM: AB COMPONENT: CON MANUFACTURER: A348
REPORTABLE NPRDS: YES

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On August 28, 1989, at 2057 PDT, with Unit 2 in Mode 1 at 100 percent power, operators initiated a manual reactor trip after observing electrical ground alarms for Reactor Coolant Pump (RCP) 2-1, Circulating Water Pumps (CWPs) 2-1 and 2-2, and the Auxiliary Transformer, and elevated, fluctuating motor current for RCP 2-1. Operators tripped the reactor and then tripped RCP 2-1. Feeder ground alarms for RCP 2-1 and both CWPs cleared. At 2115 PDT, the Unit was stabilized in Mode 3 with an RCS temperature of approximately 525 F. In accordance with 10 CFR 50.72(b)(2)(ii) a 4-hour Non-Emergency Report was completed at 2205 PDT on August 28, 1989.

The event was caused by an inadequate electrical connection on RCP 2-1.

All 12kv electrical connectors, including the failed connector, were

replaced on RCP 2-1. All other 12kv connectors for Unit 2 RCPs were examined to the extent practicable with no abnormalities found.

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END OF ABSTRACT

I. Plant Conditions

The Unit was in Mode 1 (Power Operation) at 100 percent power.

II. Description of Event

A. Event:

On August 28, 1989, at 2057 PDT, with Unit 2 in Mode 1 at 100 percent power, electrical ground alarms were received for Reactor Coolant Pump (RCP) 2-1 (AB)(P), Circulating Water Pumps (CHPs) 2-1 and 2-2 (KE)(P), and the Auxiliary Transformer (EA)(XFMR). Fire watch personnel, monitoring fire detector panels (IC)(PL) in the control room, notified licensed control room operators that fire detectors for the RCP 2-1 vault and another containment detector were in alarm. Licensed operators observed the ammeter for RCP 2-1 indicating elevated, fluctuating motor current, and initiated a manual reactor trip at 2057 PDT. Operators tripped the reactor and then tripped RCP 2-1. Feeder ground alarms for RCP 2-1 and both CWPs cleared.

A greater than normal RCS cooldown occurred following the reactor trip. This was caused by the combination of the loss of one RCP and the inability to quickly relatch the turbine. Relatching the turbine following a reactor trip is necessary to isolate a direct path for steam flow from the main steam header to the condenser. The turbine was unable to be relatched due to the presence of a locked-in turbine trip signal from the Anticipated Transient Without Scram Mitigation System Actuation Circuitry (AMSAC) that was actuated due to low steam generator levels. Low steam generator levels are expected due to shrink following a reactor trip. Once the reason for the turbine trip signal was determined, AMSAC was reset and the turbine was relatched within 15 minutes of the reactor trip, terminating RCS cooldown. at an RCS temperature of approximately 525 F.

Following the turbine trip, the Unit 2 turbine electro-hydraulic (EH) reservoir low level lockout relay was actuated, tripping the running EH pump. An investigation determined the relay was actuated by post-turbine

trip EH reservoir turbulence caused by EH fluid drain flow. In addition, during the post trip recovery, the main turbine emergency trip solenoid valve, SV-40, failed to seat and had to be mechanically agitated to latch the turbine. An investigation determined that the solenoid plunger in SV-40 did not actuate due to foulding from age and environment. The valve was replaced.

In accordance with 10 CFR 50.72 (b)(2)(ii) a 4-hour Non-Emergency Report was completed at 2205 PDT on August 28, 1989.

B. Inoperable structures, components, or systems that contributed to the event:

Reactor Coolant Pump 2-1

C. Dates and approximate times for major occurrences:

1. August 28, 1989, at 2055 PDT: Annunciator system alarms were received for RCP 2-1, and both CWPs 2-1 and 2-2 feeder ground relays. Annunciator system alarm was received for 2-1 Auxiliary Transformer ground overcurrent relay.

2. August 28, 1989, at 2056 PDT: Fire detectors for RCP 2-1 vault and another containment detector alarmed. RCP 2-1 ammeter was indicating elevated, fluctuating motor current.

3. August 28, 1989, at 2057 PDT: Event date and Discovery Date. Manual Reactor Trip was initiated. RCP 2-1 was manually tripped, feeder ground alarms for this pump and both CWPs cleared.

4. August 28, 1989, at 2101 PDT: AMSAC trip annunciation clears.

5. August 28, 1989, at 2110 PDT: AMSAC was manually reset, allowing main turbine to be

latched, terminating RCS
cooldown. RCS temperature was
approximately 525 F.

6. August 28, 1989, at 2115 PDT: All emergency procedure
actions were completed. Unit
was stabilized in Mode 3.

7. August 28, 1989, at 2205 PDT: 4-hour Non-Emergency Report
was completed in accordance
with 10 CFR 50.72 (b)(2)(ii).

D. Other systems or secondary functions affected:

1. A computer card in the annunciator typewriter (IB)(TPW) failed,
allowing 45 seconds of data to be unrecorded. While this was not
a direct result of the Unit 2 trip, it is significant in that
some transient data is missing for this event.

2. Main feedwater pumps 2-1 and 2-2 (SJ)(P) tripped. A review of
the annunciator typewriter and P-250 alarm typewriter (ID)(TPW)
was inconclusive as to why the main feedwater pumps tripped
during the event. The annunciator typewriter printout did not
have printed annunciation of the main feedwater pump trips.
However, main feedwater flow was observed by operators to
decrease to zero early in the event. This may have occurred
during the missing 45 seconds of data.

E. Method of discovery:

The event was immediately apparent to the control room operators due
to alarms and indications.

F. Operator actions:

After initiating a manual trip on Unit 2, licensed operators manually
tripped RCP 2-1 and stabilized the Unit in Mode 3 in accordance with
plant emergency procedures.

G. Safety system responses:

1. The reactor trip breakers (JC)(BKR) opened.

2. The control rod drive mechanism (AA)(DRIV) allowed the control

rods to drop into the reactor.

3. Diesel generator 2-2 (EK)(DG) started but did not load.

4. Auxiliary feedwater pumps (BA)(MO)(P) started per design.

III. Cause of event

A. Immediate cause:

The event was caused by an inadequate electrical connection on RCP 2-1.

B. Root Cause:

PG&E determined the most likely root cause of the event was failure of the RCP 2-1 load side, factory installed, bolted 12kv phase A termination on the ESNA stationary bushing. The actual failure apparently occurred at the bolted interface, not at the crimped cable to lug connection. An inspection of an identical connection on another phase (phase C) determined that the connection was beginning to loosen, and, if left uncorrected, may have eventually failed. A definitive root cause cannot be positively established because all evidence was destroyed when the connector failed.

PG&E evaluated the following potential root causes:

1. Material Degradation
RCP 2-1 has been operating reliably since 1985, and has been in continuous operation since December 1988 (9 months).

RCP 2-1 phase B and C connections were inspected to determine if vacuum pressure impregnation (VPI), which had been performed in 1988. degraded the connector bushings. This process was also used as a rework process on RCP 2-2. No insulating material was found between the bolted connections. Based on the inspection of RCP 2-1 terminations, the VPI process is not a generic concern for termination quality

A thermal scan of the RCP 2-2, 2-3, and 2-4 electrical connections did not reveal any existing high resistance condition that could indicate that a premature failure of the

connections was imminent.

2. Design

The design has proven to be reliable over several years operation. There are no reported failures of this component to the Nuclear Power Reliability Data System (NPRDS). A review of U.S. nuclear plants' Licensee Event Reports (LERS) failed to identify any similar problems with this type of electrical connector.

3. Installation

RCP 2-1 electrical connectors are as originally installed by Westinghouse. The subject connector destroyed itself upon failure, and insufficient material was available for examination. However, based upon an examination of the remaining phase connections to RCP 2-1, phase B was found to be properly connected. Phase C was loose, with a piece of solder between the lug and fitting, resulting in a less than flush connection and possible source of resistance, heat, and premature failure if left undetected. One phase connector was replaced on RCP 2-2 in July 1988 (see LER 2-88-008-00) due to galling of the electrical connector during installation in 1984. RCPs 2-3 and 2-4 connections were reworked by Visalia Electric in 1984 and 1985, respectiv
ly.

4. Manufacturing

The subject connector destroyed itself upon failure, and insufficient material was available for examination. An inspection of an identical connection on another phase (phase C) determined that the connection was beginning to loosen, and, if left uncorrected, may have eventually failed.

5. Preventive Maintenance

Preventive maintenance is not performed on the RCP power connectors. Manufacturer's instructions do not recommend any preventive maintenance and the design should not require preventive maintenance. Therefore, lack of such maintenance is

not considered to be a contributor to this event.

6. Testing

This event was not caused by a missed, incomplete, or inadequate testing. The RCP connectors were inspected for high resistance using a heat detection device in 1988 with no abnormal indications received.

7. End-of-life Failure

The failed connector was not at the end of its normal service life, thus, end-of life cannot be considered to be a contributing factor.

IV. Analysis of Event

This event consisted of an operator initiated reactor trip. The trip was initiated in response to an RCP with an electrical fault, and to protect plant equipment. A reactor trip from 100 percent power and a partial loss of forced reactor coolant flow is a previously analyzed Condition II event. Thus the health and safety of the public was not adversely affected by this event.

V. Corrective Actions

A. Immediate Corrective Actions:

The failed electrical connector to RCP 2-1 was replaced along with the other two phase connections. Other connectors on all Unit 2 RCPs were thermographically scanned for connection integrity and were found to be reading approximately the same value.

B. Corrective Actions to Prevent Recurrence:

1. RCP 2-1 stator will be replaced or inspected during the next refueling outage for Unit 2. The electrical connections to RCP 2-2 will also be inspected during the next refueling outage.

2. RCPs 1-2 and 1-3 for Unit 1 and RCPs 2-3 and 2-4 for Unit 2 have been reworked by Visalia Electric and do not require further maintenance or inspection. RCP 1-4 stator will be

replaced during the next refueling outage for Unit 1. The electrical connections to RCP 1-1 will also be inspected during the next refueling outage for Unit 1.

3. RCP 2-2 stator is planned for replacement during the fourth cycle Unit 2 refueling outage.

4. RCP 1-1 stator is planned for replacement during the fourth cycle Unit 1 refueling outage.

5. The annunciator typewriter is planned for replacement during the next refueling outage for each Unit, which should correct the problems experienced during this event.

6. The problems with the AMSAC and solenoid valve, SV-40, are being investigated separately. This action will be tracked by plant action request.

VI. Additional Information

A. Failed components:

Power Distribution Connector
650LR
Elastimold Division of AMERACE Corporation

B. Previous LERs on similar events:

LER 2-88-008 described a Unit trip and subsequent safety injection following an electrical ground on a connector to reactor coolant pump 2-2 due to galling on the threads of an aluminum stud. The corrective actions that were implemented for this previous event, such as additional operator training, were instrumental in the prompt identification and corrective actions taken in response to this event.

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ATTACHMENT 1 TO 8910030097 PAGE 1 OF 1

Pacific Gas and Electric Company
77 Beale Street James D. Shiffer
San Francisco,CA 94106 Vice President
415/972-7000 Nuclear Power Generation
TWX 910-372-6587

September 27, 1989

PG&E Letter No. DCL-89-251

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Re: Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Licensee Event Report 2-89-008-00
Manual Reactor Trip Due to a Reactor Coolant Pump
Electrical Fault Due to a Failure of a Load Side Bolted
Termination

Gentlemen:

Pursuant to 10 CFR 50.73(a)(2)(iv), PG&E is submitting the enclosed Licensee Event Report (LER) concerning a manual reactor trip due to an electrical fault on Reactor Coolant Pump 2-1.

This event has in no way affected the public's health and safety. Kindly acknowledge receipt of this material on the enclosed copy of this letter and return it in the enclosed addressed envelope.

Sincerely,

J. D. Shiffer

cc: J. B. Martin
M. M. Mendonca
P. P. Narbut
H. Rood
B. H. Vogler
CPUC
Diablo Distribution
INPO

Enclosure

DCO-89-EM-NO83

2876S/0071K/DY/2246

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